ITEM 554
EROSION CONTROL MATTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. An erosion control mat (ECM) is a degradable erosion control blanket (ECB) designed to hold seed and soil in place until vegetation is established in disturbed areas or is a synthetic turf reinforcement mat (TRM) combining vegetative growth and synthetic materials to form a high-strength mat that helps prevent soil erosion in channels and on steep slopes.

1.2 SCHEDULE

A. Prior to start of construction, submit schedules to the City of San Antonio and Engineer for accomplishment of temporary and permanent erosion control work included in the construction drawings, as are applicable for clearing and grubbing, grading, construction and paving. Also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials.

1.3 CONFLICT

A. In the event of a conflict between these requirements and storm water pollution control laws, rules or regulations of other Federal, State, or Local agencies, the more restrictive laws, rules or regulations shall apply.

1.4 SUBMITTALS

A. The submittal requirements for this specification item shall include the erosion control matting type and sample, have certified Minimum Average Roll Values (MARV) for physical properties, as derived from quality control testing performed by a Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) accredited laboratory, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

PART 2 – MATERIALS

2.1 EROSION CONTROL BLANKETS (ECBs) - TEMPORARY

A. Type 1A shall consist of 100% wheat straw or excelsior mechanically bound and covered with degradable netting, single or double netting as specified by the City of San Antonio. The straw or excelsior shall be homogeneously blended and evenly distributed throughout the blanket. The netting shall be rapid degrading polypropylene (< 90 days) or photodegradable polypropylene (≥ 90 days < 1 year) with mesh openings of approximately 3/8 in. by 3/8 in. (11 mm by 11 mm). The blanket shall be sewn on approximately 2 in. (51 mm) centers with degradable polypropylene thread. *For applications see Tables 2and 4.*

B. Type 2A shall consist of 70% wheat straw and 30% coconut fiber or 100% excelsior mechanically bound and covered on both sides by netting. The straw and coconut fiber or excelsior shall be homogeneously blended and evenly distributed throughout the blanket. The bottom netting shall be photodegradable polypropylene with mesh openings of approximately 3/8 in. by 3/8 in. (11 mm by 11 mm). The top netting shall be photodegradable polypropylene with mesh openings of approximately 5/8 in. x 5/8 in. (16

mm by 16 mm). The blanket shall be sewn on approximately 2 in. (51 mm) centers with degradable polypropylene thread. *For applications see Tables 2and 4.*

C. Type 3A shall consist of 100% coconut fiber or excelsior mechanically bound and covered on both sides by netting. The coconut/ excelsior fiber shall be homogeneously blended and evenly distributed throughout the blanket. Both the top and bottom nettings shall be photodegradable polypropylene with mesh openings of approximately 5/8 in. by 5/8 in. (16 mm by 16 mm). The blanket shall be sewn on approximately 2 in. (51 mm) centers with degradable polypropylene thread. *For applications see Tables 2and 4.*

Products in each category shall have the following Minimum Average Roll Values (MARV) for physical properties, as derived from quality control testing performed by a Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) accredited laboratory. Letters of certification signed by a responsible representative of the manufacturer shall be sent within 24 hours of each truckload shipment of material to the construction site.

TABLE 1: Temporary Erosion Control Blanket Physical Properties

			TYPICAL[1]		
	Property	**TEST METHOD**	**Type 1A**	**Type 2A**	**Type 3A**
Physical	Mass/Unit Area	ASTM D5261	8.0 oz/yd^2 (271 g/m^2)	8.8 oz/yd^2 (298 g/m^2)	8.8 oz/yd^2 (298 g/m^2)
	Thickness	ASTM D1777	0.25 in (6 mm)	0.40 in (10.16 mm)	0.30 in (7.62 mm)
	Fiber Composition	Observed	Wheat straw/ excelsior	70% wheat straw / 30% coconut or 100% excelsior	Coconut or 100% excelsior
Mechanical	Grab Tensile Strength	ASTM D5035	75 x 75 lb/ft (1 x 1 kN/m)	100 x 100 lb/ft (1.46 x 1.46 kN/m)	150 x 150 lb/ft (2.19 x 2.19 kN/m)
	Grab Elongation	ASTM D5035	25%	30%	25%
	Vegetated Velocity[2]	---	$\leq$ 5 ft/sec (1.5 m/sec)	$\leq$ 5 ft/sec (1.5 m/sec)	$\leq$ 5 ft/sec (1.5 m/sec)

Performance	Unvegetated Shear Stress[3]	---	1.5 lb/ft^2 (72 N/m^2)	1.75 lb/ft^2 (84 N/m^2)	2.0 lb/ft^2 (96 N/m^2)
Endurance	Functional Longevity	Observed	≤ 12 months	≤ 24 months	≤ 36 months

Note:

1. A typical value is the average value obtained when testing the product
2. Maximum permissible design values based on short-term peak flow duration (0.5 hr), vegetated data obtained at Department-approved independent hydraulics testing facility on an erodible soil bed.
3. Maximum permissible design values based on short-term peak flow duration (0.5 hr), unvegetated data obtained at Department-approved independent hydraulics testing facility on an erodible soil bed.
   Shear (kN/m^3) = unit weight of water (9.81 kN/m^3) x depth (m) x slope (m/m) in a "hydraulically wide" channel.
   Shear (lb/ft^2) = unit weight of water (62.4 lbs/ft$^{3)}$ x depth (ft) x slope (ft/ft) in a "hydraulically wide" channel.

TABLE 1

TABLE 2: ECB and TRM Selection Guide for Slope Applications

		Slope Batter						
Functional Longevity (months)		*5.0H:1V*	*4.0H:1V*	*3.0H:1V*	*2.0H:1V*	*1.5H:1V*	*1.0H:1V*	*0.5H:1VH*
	3 – 12	Type 1A – Straw or excelsior with Degradable Netting.						
	12 – 24	Type 2A – Coconut/Straw or excelsior with Two Degradable Nets						
	24 – 36	Type 3A – Coconut or excelsior with Two Degradable Nets						
	> 36	Turf Reinforcement Mats (TRM)						

Note: 1) For critical structures and/or 2H: 1V slopes longer than 50 ft a TRM should be considered.
2) For design purposes only. For slopes steeper than 2:1, please consult with City of San Antonio Director of Public Works for approval.

2.2 TURF REINFORCEMENT MATS (TRMs) – PERMANENT

The contractor shall submit, as a requirement of an acceptable bid, the name and manufacturer of the TRM on the bid form of this project.

A. Type 1B Turf Reinforcement Mat – shall be constructed of a web of mechanically or melt

bonded polymer netting, monofilaments or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion or the placement of synthetic fibers between two high-strength, biaxially oriented nets mechanically bound by parallel stitching with polyolefin thread. Products composed solely of synthetic materials shall be considered to be Long-Term Non-Degradable ($\geq$ 5 years functional longevity). Products containing a degradable fiber matrix shall be defined as a Long-Term Degradable (< 5 years functional longevity). *For applications see Tables 2and 4.*

B. Type 2B Turf Reinforcement Mat – shall be constructed of a web of mechanically or melt bonded polymer netting, monofilaments or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion or the placement of fibers between two high-strength, biaxially oriented nets mechanically bound by parallel stitching with polyolefin thread. Type 2B shall be defined as Long-Term Non-Degradable material designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation for a period of time exceeding 5 years. All components of Types 2B shall be 100% synthetic and resistant to biological, chemical, ultraviolet degradation, and be tan or green in color. *For applications see Tables 2and 4.*

C. Type 3B High Survivability Turf Reinforcement Mat – shall be a three-dimensional, lofty geosynthetic specially designed for erosion control applications on steepened slopes and vegetated waterways. The matrix shall be composed of tan or green, monofilament yarns woven into a uniform configuration of resilient pyramid-like projections or entangled with a high tenacity geogrid or steel wire mesh. The matrix shall exhibit very high interlock and reinforcement capacity with both soil and root systems and demonstrate high tensile modulus. TRM's manufactured from discontinuous or loosely held together by stitched or glued, netting, or composite of any type, shall not be allowed in this category. Type 3B shall be defined as a High Survivability Long-Term Non-Degradable material designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation for a period of time exceeding 5 years. All components of Types 3B shall be 100% synthetic and resistant to biological, chemical, ultraviolet degradation. **This category should be used especially when field conditions exist with high loading and/or high survivability requirements. These requirements consist of maintenance, structural backfills protecting critical structures, utility cuts, potential traffic areas, abrasion, higher factors of safety and/or general durability concerns.**[1,2] *For applications see Tables 2and 4.*

These materials shall conform to the Minimum Average Roll Values (MARV), listed in Table 3, for physical properties, as derived from quality control testing performed by a Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) accredited laboratory:

TABLE 3: Permanent Turf Reinforcement Mat Physical Properties

1) Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03, 2003, US Department of Transportation/Federal Highway Administration, p. 647.

2) Storm Water Technology Fact Sheet: Turf Reinforcement Mats, EPA-F-99-002, 9/1999, United States Environmental Protection Agency, p.2, Fig.1.

	Property	Test Method	Type 1B[1]	Type 2B[1]	Type 3B[1]
General	Mass per Unit Area	ASTM D6475	8 oz/yd^2 (271 g/m^2)	10 oz/yd^2 (340 g/m^2)	14 oz/yd^2 (475 g/m^2)
	Thickness	ASTM D6525	0.35 in (8.9 mm)	0.50 in (12.7 mm)	0.50 in (12.7 mm)
Index	Tensile Strength [2]	ASTM D5035	145 x 110 lb/ft (2.1 x 1.6 kN/m)	170 x 130 lb/ft (2.4 x 1.8 kN/m)	3,000 x 2,100 lb/ft [3] (43.8 x 26.3 kN/m)
	Elongation	ASTM D5035	50 % (max)	50 % (max)	55 % (max)
	Porosity [4]	Calculated	95 %	95 %	95 %
	Resiliency	ASTM D6524	80 %	80 %	80 %
	UV Resistance [5]	ASTM D4355	80 % @ 1000 hrs	80 % @ 1000 hrs	90 % @ 3000 hrs
Endurance	Functional Longevity	Observed	< 5 years	> 5 years	> 5 years
Performance	Maximum Velocity[6]	---	12 ft/sec (3.7m/sec)	15 ft/sec (5.5m/sec)	25 ft/sec (7.69m/sec)
	Maximum Shear Stress [7]	--	4 lb/ft^2 (192 N/m^2)	8 lb/ft^2 (383 N/m^2)	12 lb/ft^2 (575 N/m^2)

Notes:

1 All physical property values shall be derived from quality control testing performed by a GAI-LAP accredited lab.
2 Values of both machine and cross machine directions, respectively, under dry or saturated conditions.
3 As referenced by the proposed ECTC guidance specification to FHWA for High Survivability Turf Reinforcement Mat.
4 Porosity calculated based on unit weight, thickness and specific gravity.
5 Tensile strength retained of all components after exposure.
6 Maximum permissible design values based on short-term peak flow duration (0.5 hr), vegetated data obtained at Department-approved independent hydraulics testing facility on an erodible soil bed.
7 Shear (kN/m^3) = unit weight of water (9.81 kN/m^3) x depth (m) x slope (m/m) in a "hydraulically wide" channel. Shear (lb/ft^2) = unit weight of water (62.4 lbs/ft$^{3)}$ x depth (ft) x slope (ft/ft) in a "hydraulically wide" channel.

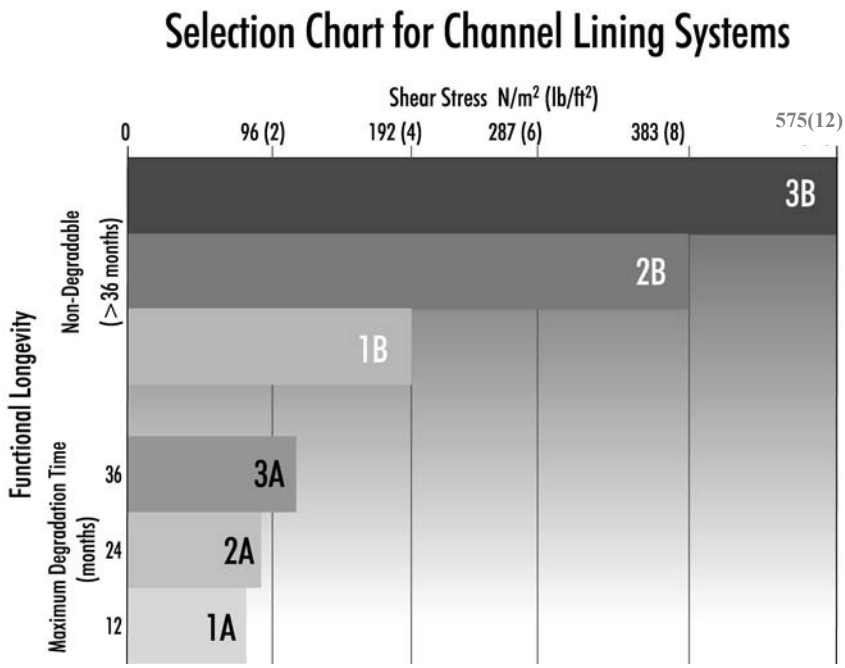

TABLE 4: Selection Chart for Channel Lining Systems

2.3 QUALITY ASSURANCE SAMPLING, TESTING AND ACCEPTANCE

A. Rolled erosion control products (RECPs) shall be subject to sampling and testing to verify conformance with this specification. Sampling for testing shall be in accordance with ASTM D 4354.

B. Acceptance shall be in accordance with ASTM D 4759 based on testing of either conformance samples obtained using Procedure A of ASTM D 4354, or based on manufacturer's certification and testing of quality control samples obtained using Procedure B of ASTM D 4354.

C. Quality Assurance Sampling and Testing will be waived for products manufactured at an ISO 9002 Certified Manufacturing Facility. Documentation of ISO 9002 Certification shall be provided upon request.

D. Alternate RECPs not strictly conforming to this specification must be approved by the City of San Antonio 10 days prior to bid.

2.4 MANUFACTURING QUALITY CONTROL

A. Manufacturing Quality Control (MQC) testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the turf reinforcement mat, at a frequency exceeding ASTM D 4354, with following minimum acceptable testing frequency:

Property	**Test Method**	***Temporary*** **Test Frequency**	***Permanent*** **Test Frequency Tests/m^2 (yd^2) of production**
Mass Per Unit Area	ASTM D-5261	1/Production Run	1/20,000 (1/24,000)
Tensile Strength	ASTM D-5035	1/Production Run	1/20,000 (1/24,000)
Tensile Elongation	ASTM D-5035	1/Production Run	1/20,000 (1/24,000)
Ground Cover Factor	Light Projection Analysis	1/Production Run	1/20,000 (1/24,000)

TABLE 5: Minimum Acceptable Testing Frequency for Index Properties

B. Letters of certification signed by a responsible representative of the manufacturer shall be sent within 24 hrs of each truckload shipment of material to the jobsite.

Part 3 – Execution

3.1 SITE PREPARATION – ECBS and TRMs

A. Grade and compact areas to be treated with RECP and compact as indicated or as directed by the City of San Antonio.

B. Remove large rocks, soil clods, vegetation, and other sharp objects (larger than 2" in diameter) that could keep the RECP from intimate contact with subgrade.

C. Prepare seedbed by loosening 50 to 75 mm (2 to 3 in) of soil below final grade. Select and apply soil amendments, fertilizer, and seed as required by the City of San Antonio to scarified surface prior to installation of the RECP (Types 1A-3A and Types 2A-2B). For Type 3B, the contractor will additionally seed and uniformly soil fill (.5 inches) with live soil on top of the mat. Successful preparation of the seedbed will result in 50 to 75 mm (2 to 3 in) of live soil. . The City of San Antonio has final determination of whether or not the soil is "live." If insitu soil is not "live", "live" soil will be imported as approved by the City of San Antonio.

D. Construct 150 x 300 mm (6 in x 12 in) anchor trench at upgrade end of installation to inhibit undermining from stray surface water. Excavate 150 x 150 mm (6 in x 6 in) check slots at 7.6 to 9.1 meter (25 to 30 feet) intervals along length of channel. At the City of San Antonio's discretion, excavated check slots may be replaced by a double row of staples offset by 6 inches and placed on 1 ft centers. Cut longitudinal anchor slots 150 x 150 mm (6 in x 6 in) at top of each side slope. The aforementioned dimensions are minimums and the dimensions detailed on the drawings will control.

3.2 INSTALLATION – ECBS and TRMs

A mandatory pre-construction conference with an Engineer representing the TRM manufacturer, contractor, and inspector must be completed. The conference is to be

scheduled by the contractor with at least one week's notice to all parties involved. Representatives may be required to be on site for installation assistance.

The following installation details are the minimums required. The installation details noted in the drawings will control the RECP installation.

A. Install the RECP at elevation and alignment indicated.
B. Beginning at downstream end in center of channel, place initial end of first roll of RECP in anchor trench and secure with ground anchor devices at 300 mm (12 in) intervals.
C. Position adjacent rolls in anchor trench in same manner, overlapping proceeding roll minimum 75 mm (3 in).
D. Secure the RECP at 300 mm (12 in) intervals along the trench, backfill and compact with specified soil or as directed by City of San Antonio.
E. Unroll center strip of RECP upstream over compacted trench. Stop at next check slot or terminal anchor trench. Unroll adjacent rolls of RECPs upstream in similar fashion, maintaining 75 mm (3 in) overlap.
F. Fold and secure the RECP snugly into transverse check slots. Lay material in bottom of slot, and then fold it back against itself as indicated. Anchor through both layers of RECP at 300 mm (12 in) intervals. Backfill with soil and compact. Continue unrolling the RECP widths upstream over compacted slot to next check slot or terminal anchor trench.
G. Secure RECP to channel bottom with ground anchoring devices at a frequency of 3 anchors per square meter (2 ½ anchors per square yard). Anchors should be a minimum of 8 gauge and 200 mm (8 in) in length or so that they have sufficient ground penetration to resist pullout. Increased anchoring frequency may be required if site conditions are such that the City of San Antonio determines it necessary.
H. At the discretion of the City of San Antonio, certain TRM's can be soil filled to improve vegetative establishment and performance. If specified in the project plans or specifications, after seeding, spread and lightly rake ½" of fine topsoil into the TRM. Smooth soil fill in order to just expose top of TRM. Do not place excessive soil above mat.
I. At the City of San Antonio's discretion a manufacturer's designated representative shall be on site for installation assistance.
J. Any installation of angular placement, overlapping around curves, or modified placement methods must be detailed on the construction drawings.
K. City of San Antonio must approve alternate installation methods prior to execution.

3.3 Irrigation, Mowing and Project Acceptance

A. Prior to project acceptance by the City of San Antonio**,** it shall be the responsibility of the contractor to establish a minimum of 70% of the area seeded shall be covered with the specified vegetation with no bare or dead spots greater than 10 square feet. The contractor shall be responsible to set up and maintain temporary irrigation, as required, to assist in establishment of vegetation.

All areas that erode prior to project acceptance shall be repaired at the expense of the contractor including necessary reseeding , watering, and repair of the RECP.

Seeded areas shall not be mowed prior to establishment of 70% vegetative density and a minimum grass growth of 3 inches. Mower height shall not be set lower than 3 inches. Throughout the duration of the project, the contractor shall be responsible for mowing to facilitate growth and shall not let the vegetation in the seeded areas exceed 18". In addition, the

Contractor shall water all grassed areas as often as necessary to establish satisfactory growth and to maintain its growth throughout the duration of the project.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement of erosion control matting will be made by the square yard of surface area covered, complete in place and ready for use as an erosion control surface treatment. (Erosion Control Matting necessary for anchorage trenches, overlaps and waste is subsidiary to the design surface area.)

4.2 PAYMENT

A. Erosion control matting, measured as herein specified, will be paid for at the unit price bid per square yard, which payment shall include furnishing all materials (including material for anchorage trenches, overlaps and waste), labor, and equipment necessary to provide a complete and finished installation as specified.

Bid Item:

Item 554: Erosion Control Matting per Square Yard

END OF SECTION